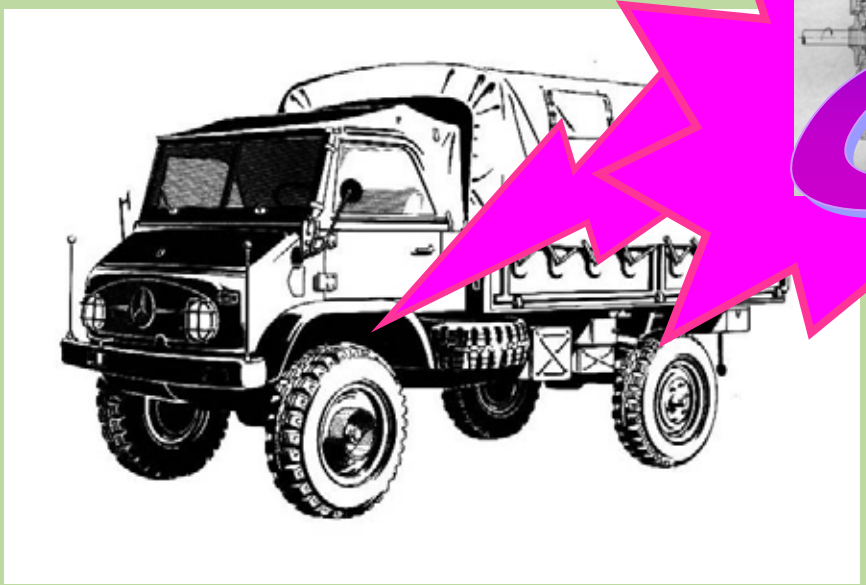
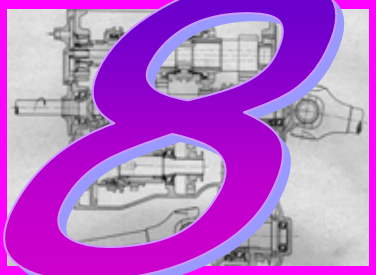
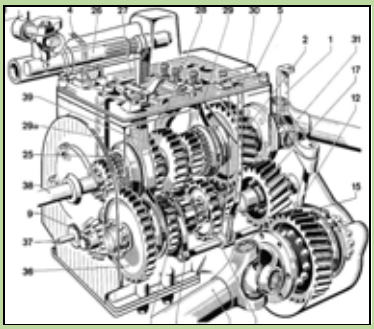
Transmission modification of the UG1/11 from the U 404 S to 8 speed.



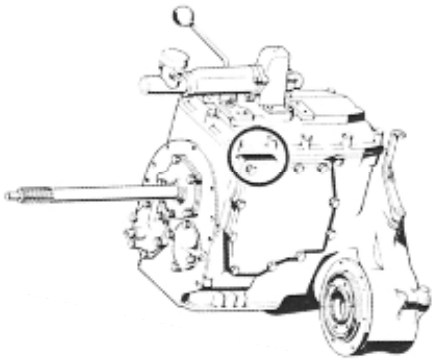


Modification of the UG1/11 transmission from the U 404 S from 6- to 8 forward speeds.

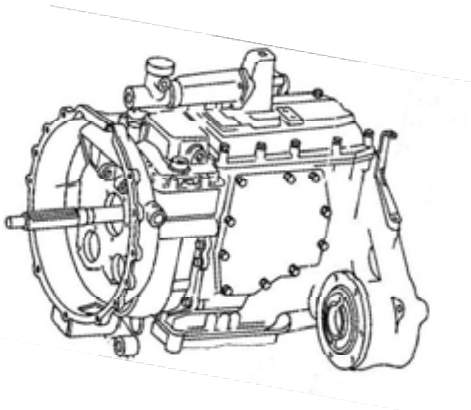


Introduction:

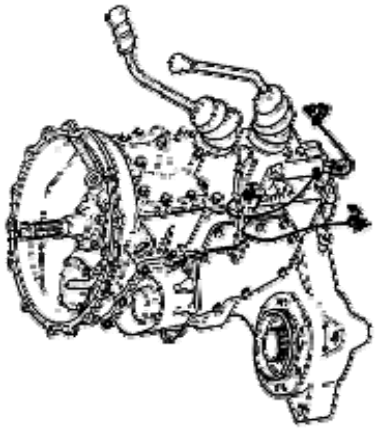
UG stands for Unimog Getriebe and the UG1/11 found in the '404 S' is the same as installed in the early Boeringer and 411's mogs, with some little changes and improvements over the time. The original design is still in all the transmissions from the U 4xx.xxx series, from the first unsynchronized UG1/11 to the synchromesh over the UG2/27 to the UG2/30 with a lot of combinations for PTO, sideway power take off and winches, splitters, creeper gears, hydraulic and air operated systems. The basic modular design is well thought, so the original idea is valid for over 55 years now with only mayor changes and developments in the brass bushings, bearings, the shift plate and that they now operate with some air cylinders.
A quick look to the 3 issues of transmissions let you recognize, that the transmission housing is still the same, but with some additional bores & mounting points, later with stronger gears - but the same basic size. You can find this transmission housing in their corresponding Mog models from the 70200, 2010, 401, 402, 403, 411, 404, 421, (406):



UG1/11 6 speed (U404S) basic 1x6 shift plate



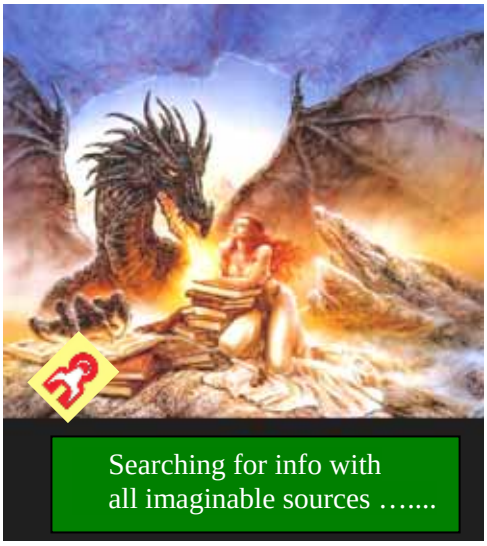
UG2/27 6,8, up to 20 speed 2x4 shift plate(U406)



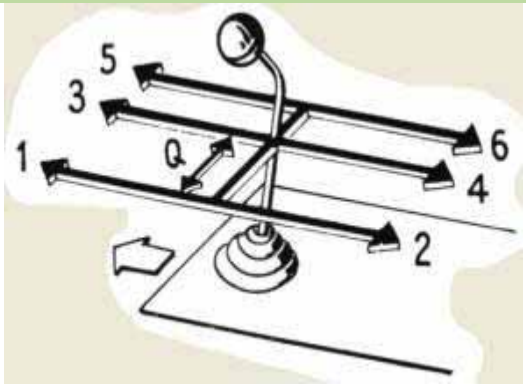
UG2/30 20 speed, new shift plate (U419, SEE)

To know really about all possible combinations, you have to think about a serious study of this topic. There where also special designs for the customer needs and military applications.

Researching for information:

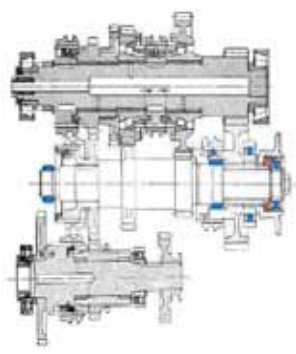


To find info about the 404S 'Mog' transmission today is difficult, especially for our old UG1/11 tranny. Thanks to the list members from RMM, Mog4x4 and MogTech, I was able to collect sufficient info from manuals, images, e-mails, photos and scanned material to see, that due to the basic, modular design of the transmission, especially the housing and the shift plate, it should be possible to modify the UG1/11 to work like the transmissions found in the U421 and U406/416 with 8 forward speeds: 4 in the low range and 4 in the high range. Here where I live in Venezuela is no 'mog' with a 2x4 transmission around, so it was a detective like work to see what the mayor differences between the 'trannies' are and what they have in common, looking only on the material collected as the source for technical information. But relatively quickly it was clear, that the mod is possible without touching the gears or shift forks inside the transmission. The clue is in the shift plate and the shift cover plate in both models. After understanding the differences, it was obvious that the old Q- shifting ("Q = Querschalten" = traverse shifting) has to be substituted with an additional lever.



The first impression may be now that you can get a 12 forward speed tranny, but no – the conversion gives you two additional speeds in the low range, like a 3rd low and 4th low speed because the original 1,2 and 3,4 positions share the same shifting fork. There will be also the two usual reverse gears plus two with higher ratio. Use wisely: Fast in reverse with a 404 makes no sense. But two additional low range gears with the original engine with only 82 hp at the clutch really could be interesting. And that leads to the question: Is this mod useful, why make such a modification, what is involved in such a work?

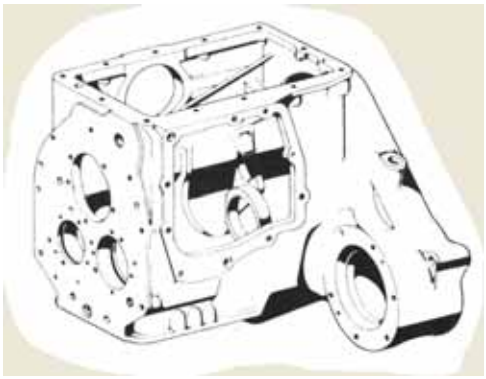
The benefits of the modification to 8 speeds:



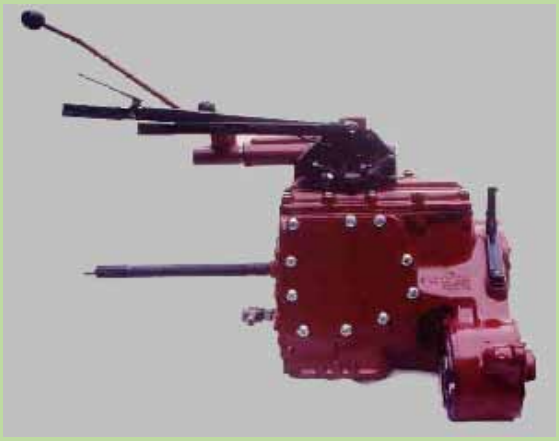
For me personally, that is no question and some 404 moggers would like not to shift so frequently between low and high range when off road, loosing impulse or battling with a dying engine. And- as the two new speeds promise a good final torque - (small gear driving a bigger gear two times) there is no doubt, the result will be great off road driving with four useful low gears without leaving the low range for shifting to a little more off road speed ! And there is some bonus too, the new gears are nice stepped with the existing gears as we will see later, with some useful overlap over the "on road" gears - just what a 404 needs.

What do you need for the 6- to 8 fwd speed conversion:

If you like to keep your Mog original, find you a shift cover with levers and a shift plate from a spare or toasted U404 tranny sitting around. If you can get those parts from a 2x4 tranny, for example from a 421 or 406 transmission, then you have found the best shortcut. With the 404S material, you need to find or fabricate the additional lever for the high/low range selection. The transmission housings are basically the same.

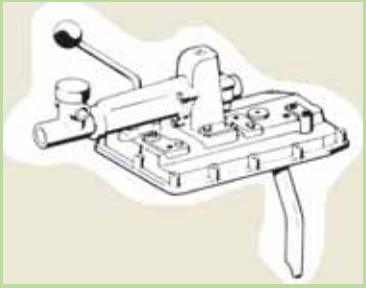


There are no special tools or knowledge needed. If you have basic tools and some skills and like wrenching, the 'mod' can be done in a couple of hours. The most time consuming work is to fabricate the lever, if you don't have already one with a 55mm finger or something similar to adapt.



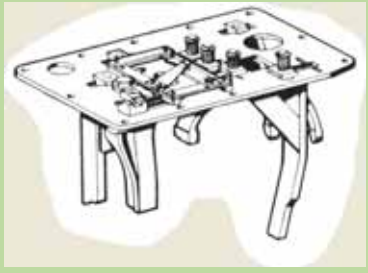
A nice finished UG1/11

An overhauled UG2/27 (with PTO) …….. you recognize the family ……..



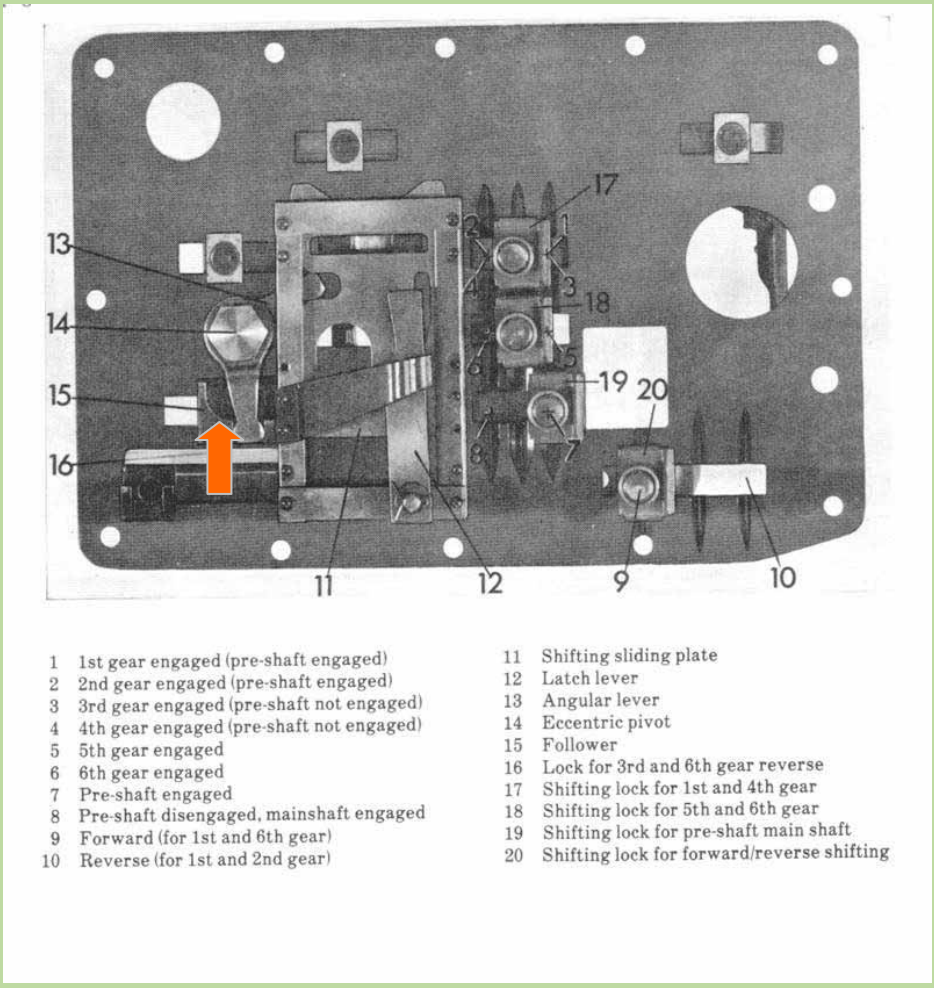
You need a shift cover…

… and a shift plate.



The theoretical part of the modification: The shift plate

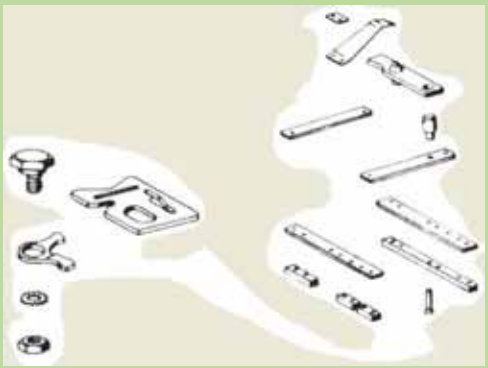
Looking now at some pictures with good detail let you quick understand what is to do here:
This is an original 6 speed shift plate found in 411, 404, 421 and 406(?) in their basic setup.



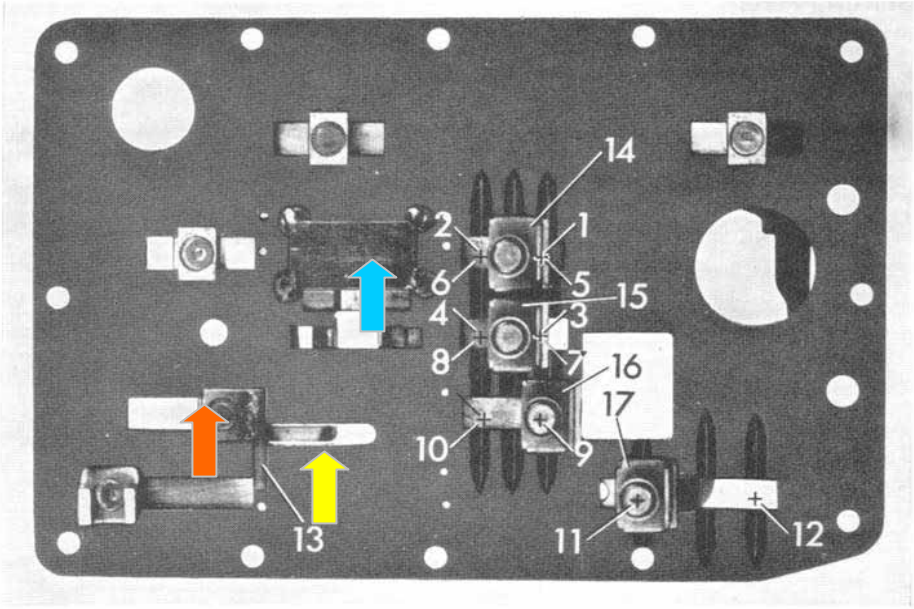
1 1st gear engaged (pre-shaft engaged)
2 2nd gear engaged (pre-shaft engaged)
3 3rd gear engaged (pre-shaft not engaged)
4 4th gear engaged (pre-shaft not engaged)
5 5th gear engaged
6 6th gear engaged
7 Pre-shaft engaged
8 Pre-shaft disengaged, mainshaft engaged
9 Forward (for 1st and 6th gear)
10 Reverse (for 1st and 2nd gear)
11 Shifting sliding plate
12 Latch lever
13 Angular lever
14 Eccentric pivot
15 Follower
16 Lock for 3rd and 6th gear reverse
17 Shifting lock for 1st and 4th gear
18 Shifting lock for 5th and 6th gear
19 Shifting lock for pre-shaft main shaft
20 Shifting lock for forward/reverse shifting

The group of parts that conforms the simple " shift logic " , items # 11,12,13,14,15 and 16 are not on the 2x4 shift plate. These parts will be taken apart for the conversion, among others. The angular lever (#13) is actuated when shifting " Q-traverse " in to low gears (1 & 2) and this unlocks the two reverse gears too. But this also blocks our additional two low gears that we want .

We do not need this few parts .....



Here is a shift plate from an UG2/27 tranny. Same size, same holes and bores, the slots for the engaged position of the shift forks. Compare !, it is the same basic plate, - fundamentally.



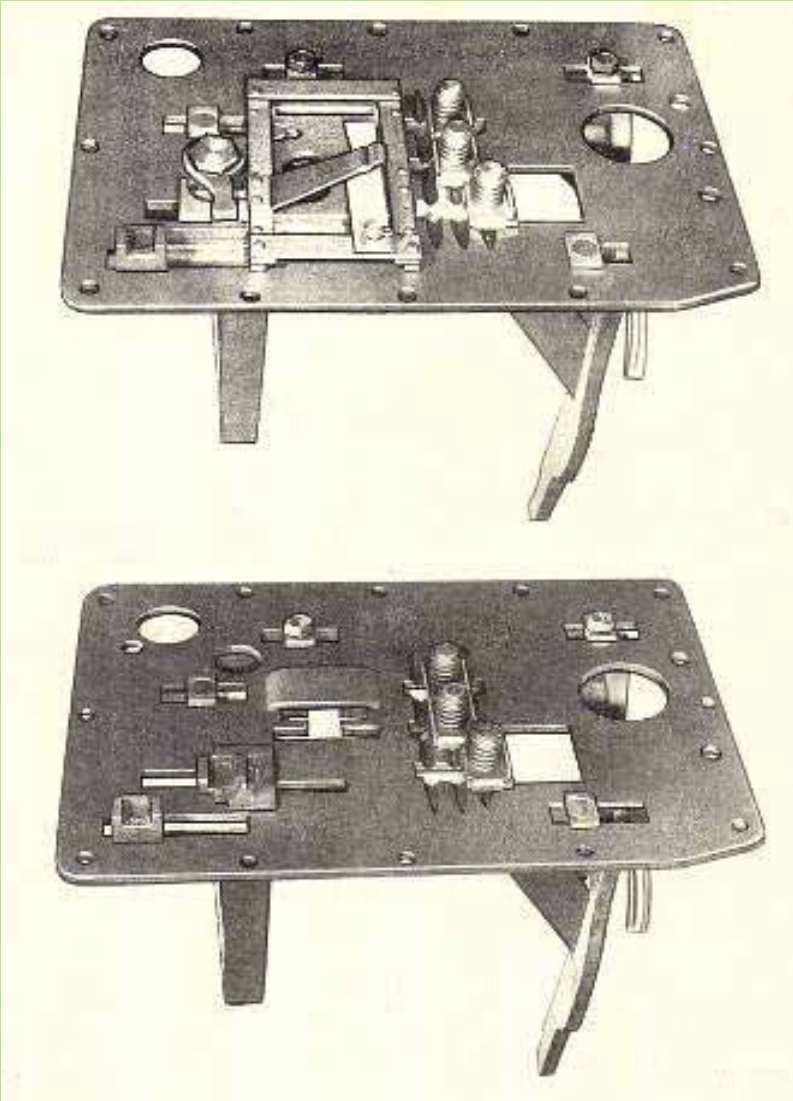
1 1st gear engaged (low range)
2 2nd gear engaged (low range)
3 3rd gear engaged (low range)
4 4th gear engaged (low range)
5 1st gear engaged (high range)
6 2nd gear engaged (high range)
7 3rd gear engaged (high range)
8 4th gear engaged (high range)
9 Low range engaged
10 Low range disengaged, High range engaged
11 Forward (low and high range)
12 Reverse (low range)
13 Lock for high range in reverse shifting position and vice versa
14 Shifting lock for 1st/2nd gear for low, high and reverse range
15 Shifting lock for 3rd/4th gear for low, high and reverse range
16 Shifting lock for low high range
17 Shifting lock for forward/reverse speeds

Figure 40 - Shifting Plate for 2 x 4 Shifting With Three shifting Lock slots for Forward/Reverse Shifting.

There is one minor difference on this plate, it is the little slot above the #13 (arrowed yellow), this could be used to shift the high/low range where it is already present if you have this version of the plate from a newer (2x4) transmission and the lever with the longer finger. If this is your case, you need to make a lever with aprox. an 80mm long finger.

For the conversion starting from a 404 (UG1) tranny there is another easy solution. The red arrow on both images (pages 5 & 6) points to the part where on the other side is the shift fork located for the selection of the high and low range.
The blue arrow points to a small 60mm x 30mm (3mm thick piece of metal) welded on to the plate; that eliminates the old 1st and 2nd gear lever positions from the 1x6 plate.
This is already the 2x4 plate and do not use that third part of the 'double "H" slot for shifting.

Here is another older image from an earlier shift plate (again with minor differences that Gaggenau changed later, - did you see them ?) that shows very good the two shift variants: First the 1x6 speed, below there is the 2x4 speed shift plate.

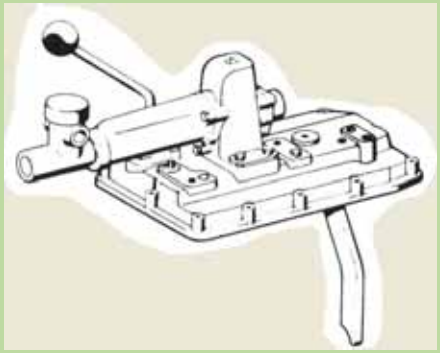


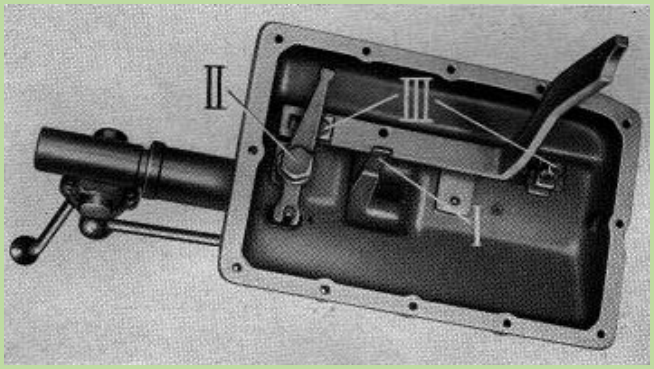
Now, let's look to the next involved component of the transmission mod : The main cover.

Remark: The photos and diagrams are regular quality, so you can zoom in (200-400x) to observe details better.

The shift cover:

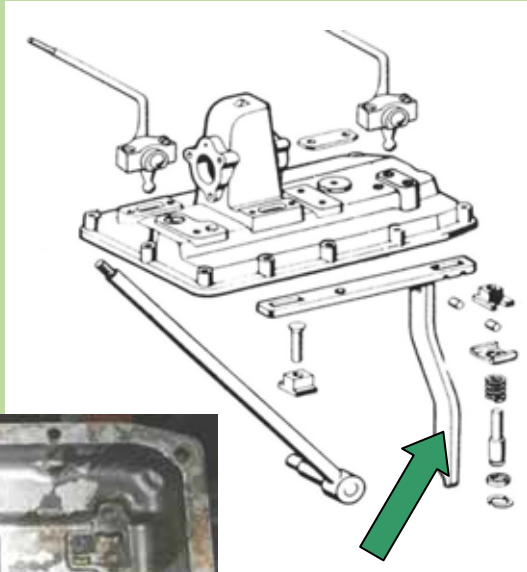
The (main) shift cover is a simple part in these versions for the UG1 and UG2 type transmissions. The two or three shift levers (I) on the top (beside the hand brake and 4x4 / difflock lever) and on the underside is only a long shift fork (III) for the "So" applications (So= **So**nderantriebe, meaning something like 'special drives' like a PTO.) and a lever (II) for the forward/reverse positions of the corresponding shift fork. That is all from the underside of the cover.



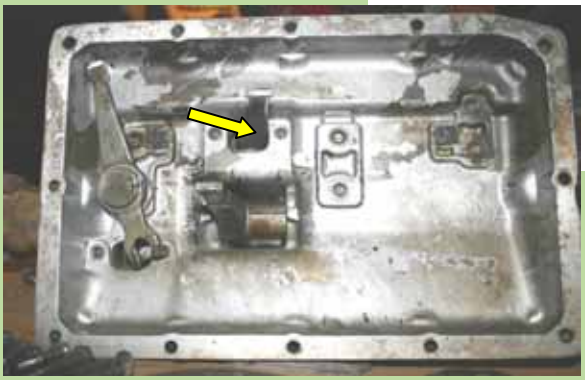


Here you have to keep in mind, as " a reminder ", that with the modification in the way I did it, you can not use a PTO from a UG1/11 (404S) when driving with the 8 speed modified transmission, because I took the place for the PTO lever for the high/low range shift lever and put the long shift fork out of the way. That is why I still keep a set of a transmission cover and an unmodified original shift plate as a spare, so I can return to the original setup if I want or if needed some day. You can use a PTO from a U421 or similar after the mod, but this is to be checked out first, but it really looks do-able.

The work on the cover plate is short:
Two big rivets must come out to take the long shift fork (arrowed green) out of the way. Then you can use this fork as raw material for the modification. It is nice 10mm steel and the bore for the lever end can be re - used for the new purpose. Details follows later.

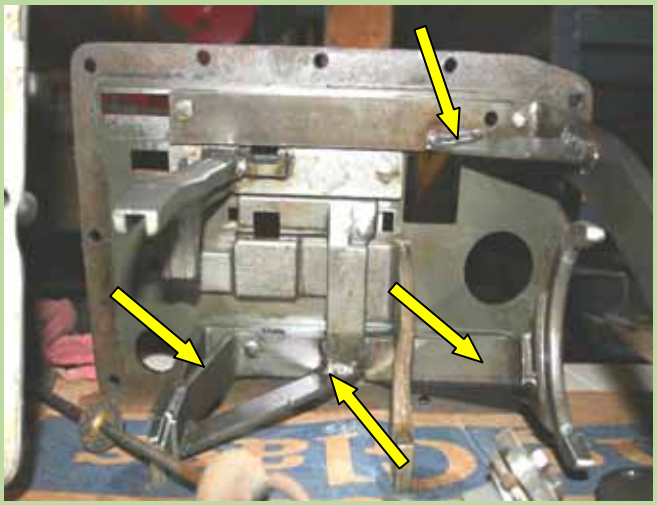


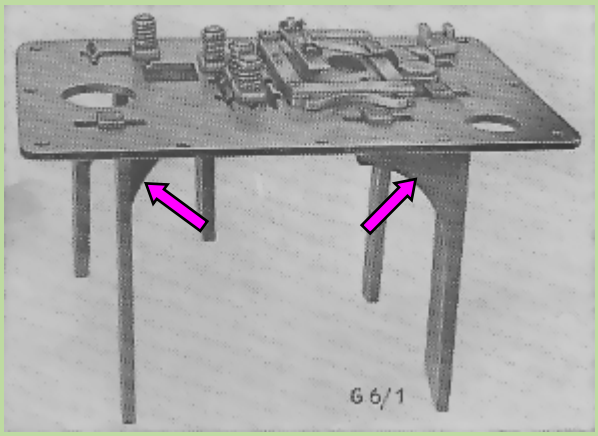
Perhaps to reduce manufacturing costs and weight, the cover from some day on is made out of aluminium casting. The cover shown is from a U421 and you can see that it is the same type as the cover from a U404 with the exception, that there is no slider and shift fork for the PTO. Also pictured is the long shifting finger for the hi/lo range (arrowed yellow).



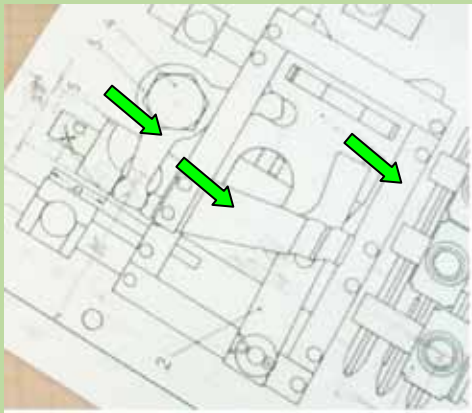
The shift plate:

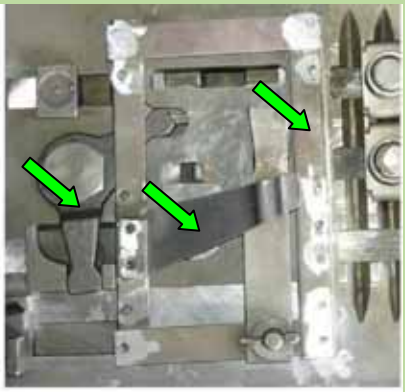
On the shift plate were arranged the entire shift tongues -and shift forks- on the underside. As there is no work to do on this parts on the underside, I go only in to the details of the top, where the 'shift logic' and shift levers actuates. As a side note, looking to the underside it seems that Gaggenau did some 'last minute' reinforcements to the shift forks, the work done here don't looks too nice (improvisation that never was refined??) and I could observe this with various plates… (See ⇩ arrows, ugly welding)
On very old pics from plates, the reinforces ⇩ were small, perhaps the original setup was too weak and bent, when a "Bub" shifts around… ;^)





Most of the modification is to be done here on the shift plate, and consists more or less in taking pieces away .





The angle lever for the 'Q' – shifting of the high /low range in the 1st and 2nd gears forward and reverse, the flat holder, the frame with all its components and the slider plate- are not needed. You can save them as spares (or elaborate a trophy for the next NWMF ……?).

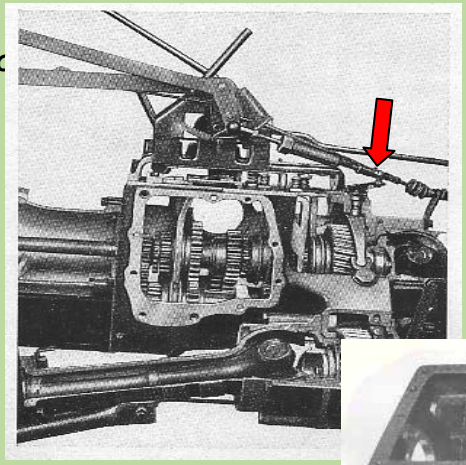
A quick sidekick in to the gearbox:

Here I put two similar images together, the left one is a UG1/11 tranny from a 404, the right one is a UG2/27 from a 416:

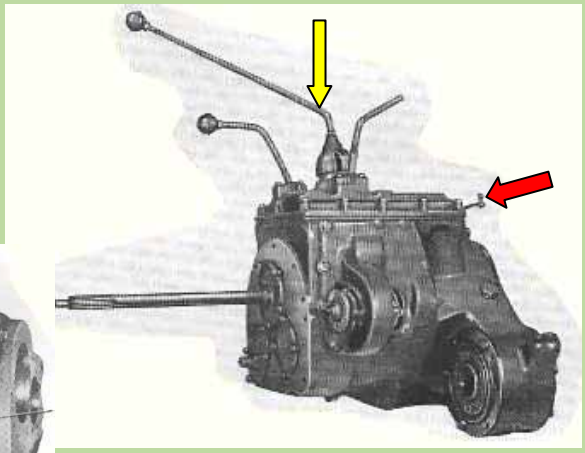
You can observe (again) that the two transmissions share the same housing, the eye catching difference is, that the gears from the UG2/27 are stronger (thicker and have a little lesser teeth), also you can see how the torque transmission goes from the right to the left, from "thinner" gears and with more teeth to the 'heavy' ones on the right. The original design is still in all transmissions: A drive shaft (input from the engine/clutch) and three shafts with the gears (pre stage shaft, counter shaft and the main shaft)

A little transmission history:

mo

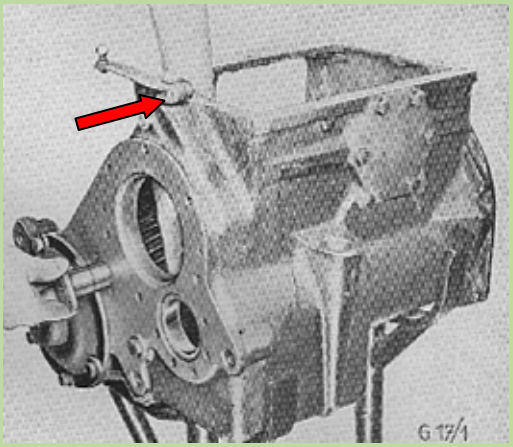


Early ⇩ designs (U411) have a different shift plate with a lever going direct through the plate with no 'turret'.

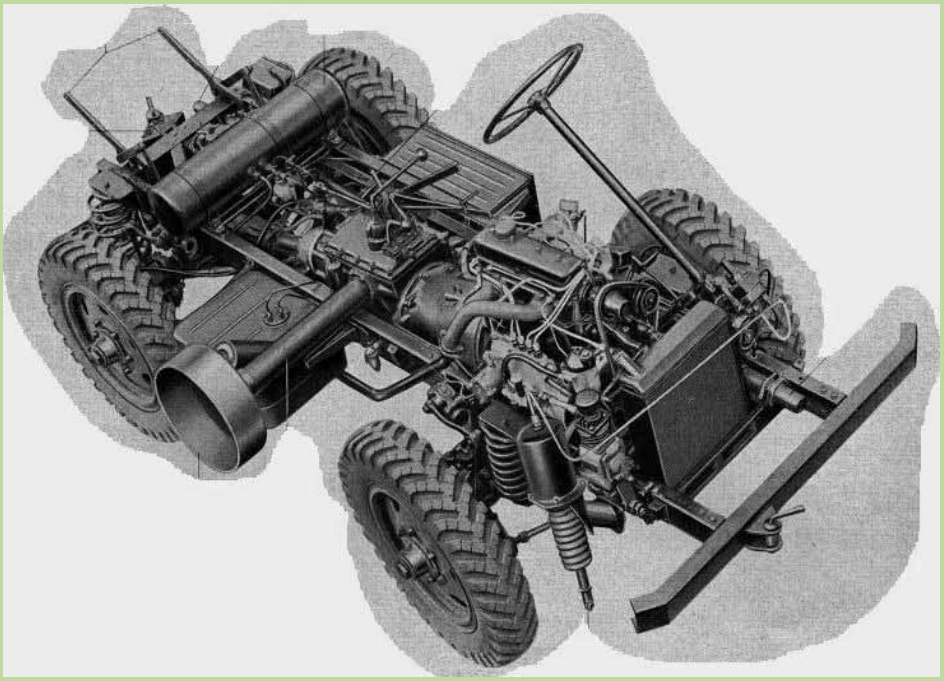


The 4x4 wheel drive is activated with a long shaft from the top of the housing to the fork (red arrows) ⇩, later the casting was modified.

Curious: The early shift plate looks similar to the modern shift plate from the U2/30 … but only from an external view at the main lever… (yellow arrow page 10)

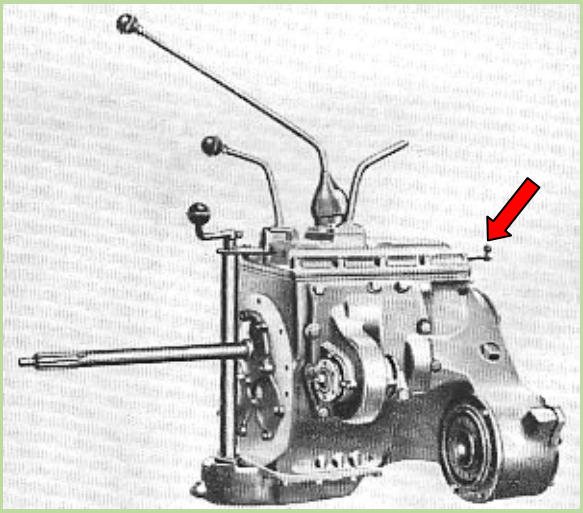


The first transmissions was not synchronized, the little 411 with the 25 hp diesel engine was a real tractor with four equal sized wheels and an incredible hauling capability.



Note the lateral power take off with a big pulley for belts or hydraulic pumps and the early type shift covers…

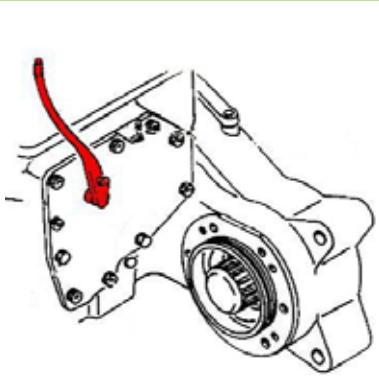
A full equipped early design transmission with creeper gears and PTO. Note the old cover and main shift lever design and the location of the 4x4 lever.

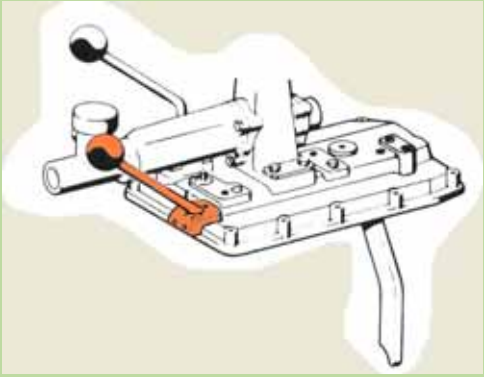


It would be interesting to know, why they did not "unlock" the transmission for 8 fwd speeds. At a first glance, there is no apparent reason other than the virtual conflict with the PTO add on. But there is more than one way to go, for sure.

Possible variations of the modification:

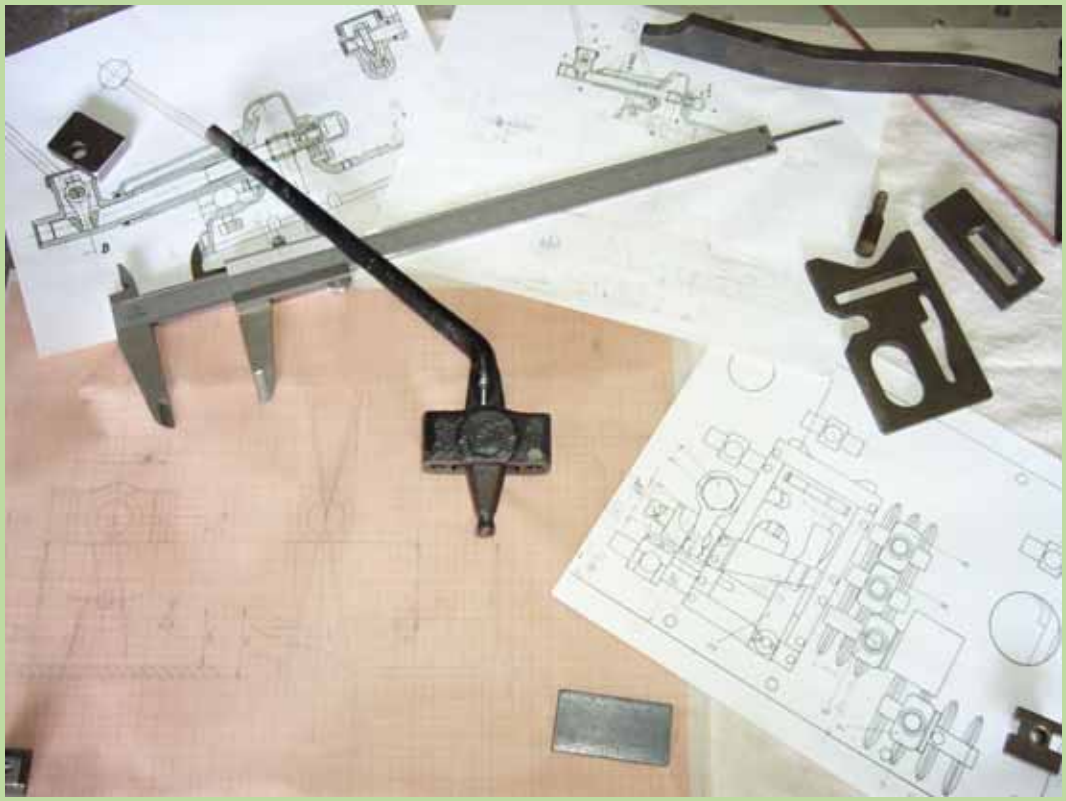
The way I choose to make the modification is because I have no PTO on the tranny and a set of spare UG1/11 main cover and shift plate lounging around. Sure there are 3, 4 or even more other ways to realize this conversion: Starting with parts from an U421/406/416 2x4 tranny, or leave the PTO shift tongue in it's place and relocate the additional lever required to the side opening plate, or mill a space on the front of the main cover for a device to accommodate the lever, think about air (manifold vacuum) operated cylinders, …… and so on .

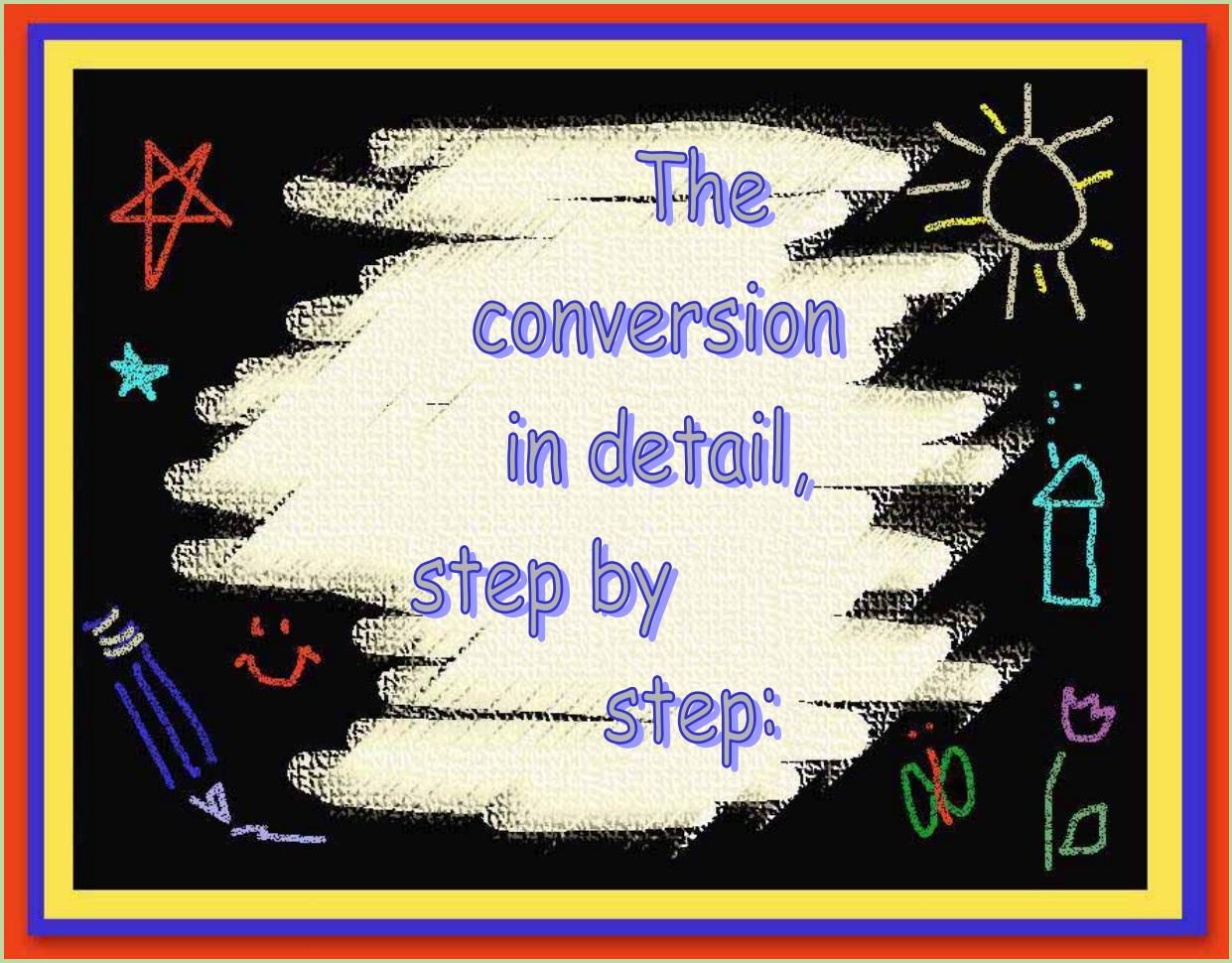




You could modify the inner pivoting arm for the fwd / reverse lever (II on page 7) and have this to actuate the high/low range and use it instead of the additional shift lever for forwards and reverse selection More than only one way to go for sure.

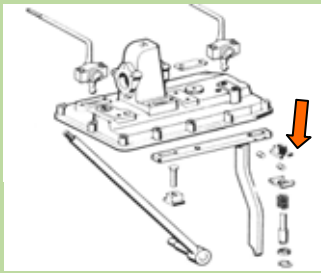
Here is an opportunity for creativity and different solutions.

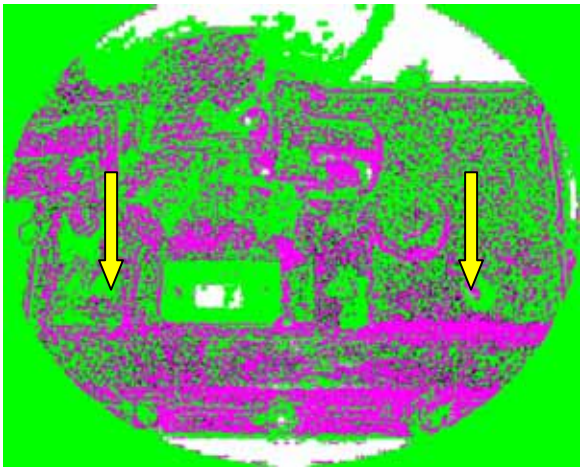




First, to take apart the main cover and the shift plate, or if you take it out from a spare transmission, please refer always to the shop manual, the procedures are well described .

Take the main cover: For easier manipulating, put the long main lever apart. On the underside, take the coil spring of the detent (safety lockers, spring retainer, roller guide and two small rollers out. See the manual page. 26.4.4.4.).





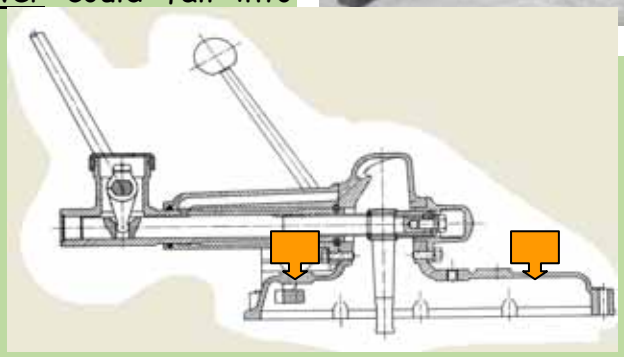
There are two big rivets that hold the sliders for the shift fork of the PTO gear. Put the main cover on the work bench or in a grip (holding it on the shift fork). On the top, punch mark the two rivets (centered) and drill with a 4mm or similar diameter about 10mm deep.

Then, with a 10mm or 11mm bore drill careful until the top of the rivet begins to spin, or you feel that it becomes loose. Take care not to drop the main cover when the last rivet comes out. Take apart the shift fork, the guide pieces and followers. Save the fork to fabricate some parts with it later.

Knock out this two rivets of the fork from the top with a punch.

When the shifting fork is apart, mark 75mm (from the right to left) and a second segment of 40mm. Cut the pieces and eliminate sharp edges, sand them. This pieces are for the connection of the new shift lever with the high/low range slider on the shift plate.

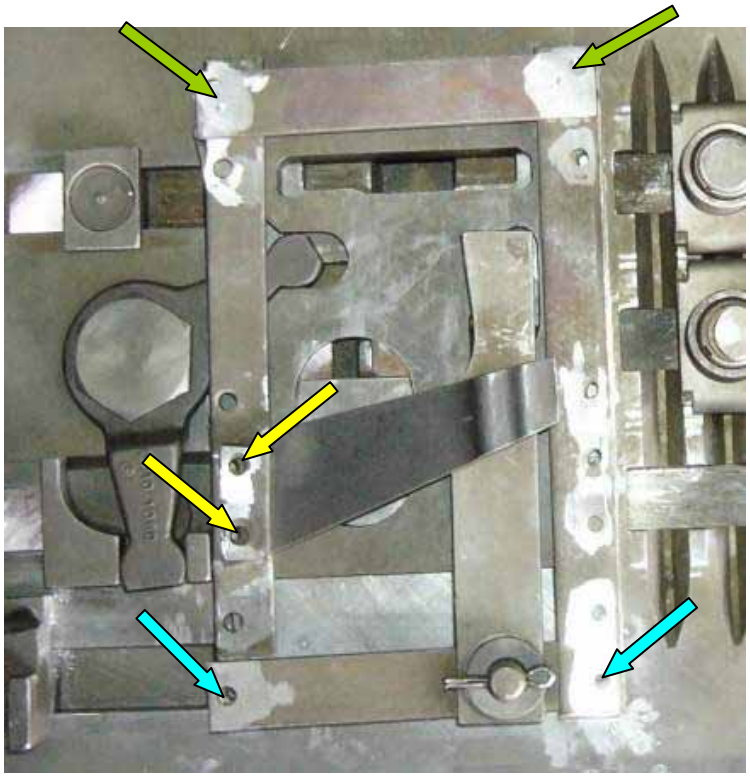
Now put two bolts (allen) with nuts where the rivets were in the main cover (s. page 12) to plug the bores. They should be at level like the rivets. Tighten well and punch mark on the underside or make a spot with the welder to make sure the nuts never could fall into the tranny.



Clean the main cover, lubricate, this part is finished 8^)

Second, put the shifting plate on the bench or grip: When you have the part cleaned and ready: To manipulate the shift plate easier, put the springs and associated parts from the fwd/rev and from the high/low range detent apart for a while.

There are two sets of: small rollers, 2 springs (they have different heights and constants - depending from where they come) 2 holders, rings and 4 lock inserts. (Don't mix them) .



With a small grinder or a "Dremel" grind the yellow arrowed rivets careful away, take the small plate and the (black) holder apart. Then grind the two light blue rivets away and take the little traverse with the lock arm (complete) apart. Help with a small flat sharp chisel and a hammer to separate the pieces. Take the slide plate out.

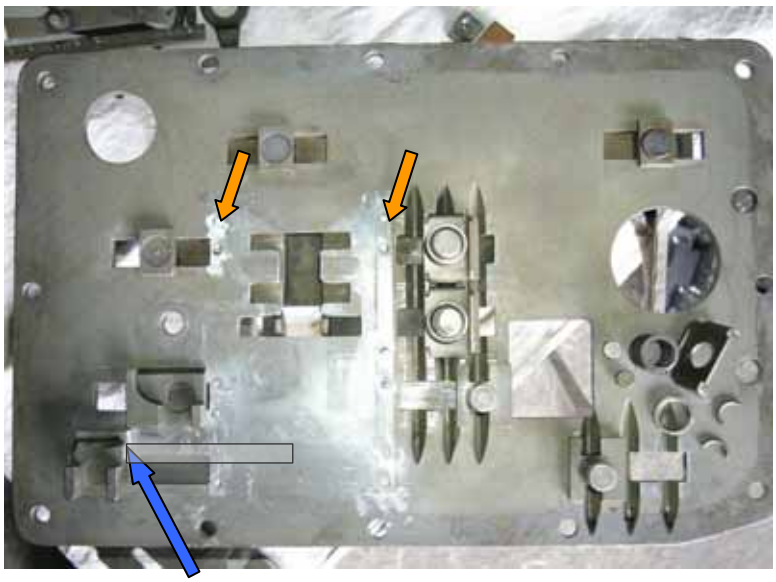
Now grind the green arrowed rivets, take the piece and continue with all the remaining rivets. Take your time and have patience. Have the chisel sharp and cut with care.

You see where my traces are.

Grind, chisel, take apart…

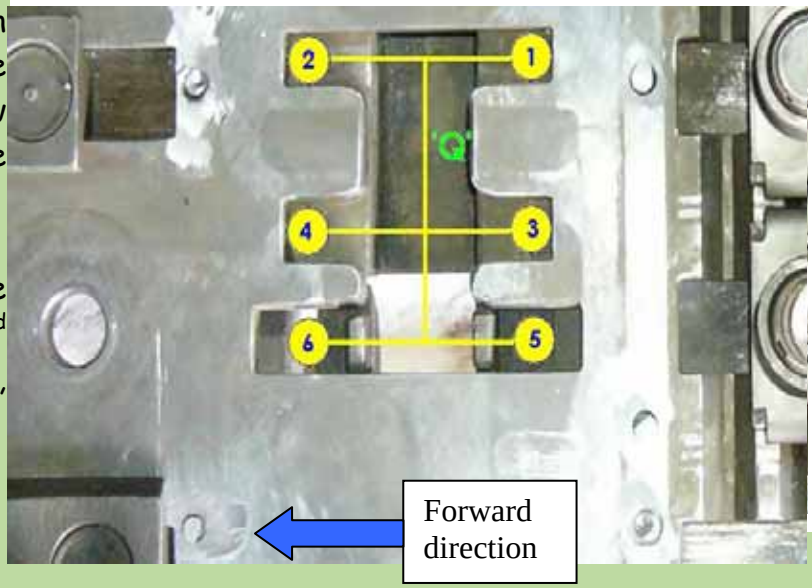
If the rivets are over the surface of the parts, regrind and help with the flat chisel to loosen the components.

Unbolt the eccentric bolt and counter screw to take the angle lever out of the way. The screw is secured with punches, but comes apart with no or little force.

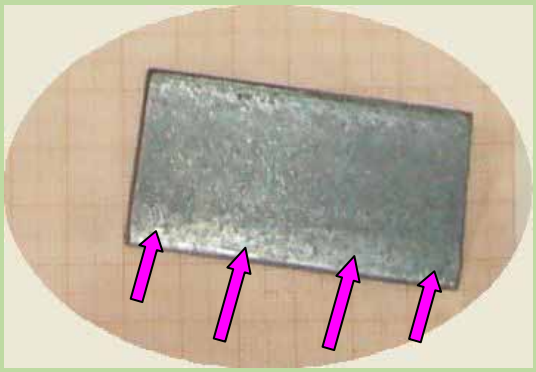


You can punch these two rivets ⇩ out to the other side. The others can be left in place, due to its shape they can not fall out and the sliders hold them from the other side. If you want, spot weld them.
Cut the square shaped pin of the security lock of the reverse gear (grey, w. blue arrow).
Now clean and smooth the area careful with a fine grinder or a polisher.
Check that no rivet is over the surface level of the plate itself.

Remember how you shifted? The positions are mirrored because the main lever works over pivoting points. You also see the large slot where the traverse (Q) shifting point was. We don't need this 'double H' pattern because we will add a new lever for the high/low range selection later. This new lever will supplant the "**Q**" transverse shifting movement.



Now a piece of steel is needed to close the part of the 'Q' and 1st and 2nd positions. Prepare a 60mm by 30mm, piece, 4 to 4.5mm thick is o.k.



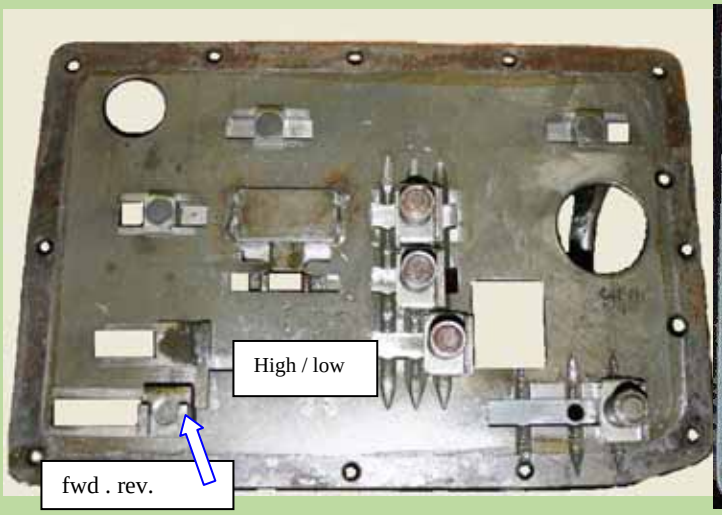
Smooth and polish the surface where the finger of the main shift lever will slide along.

Align the steel plate well to the slot in the shift plate to guarantee a good and even shift feeling.

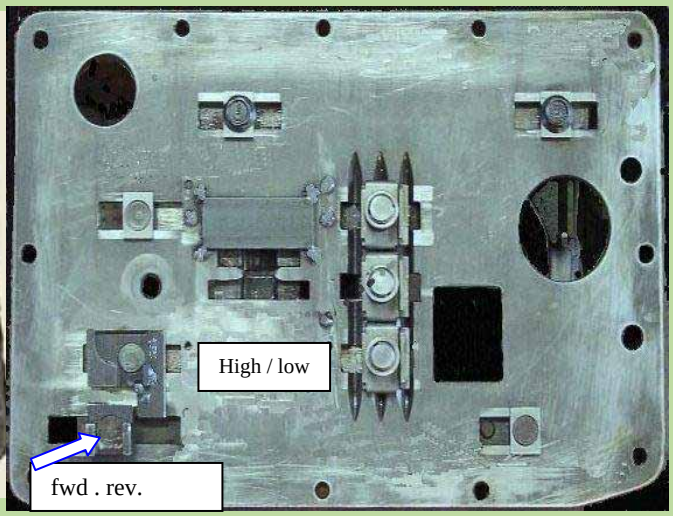
Weld at two or four points. Clean the plate, do not leave welding residues in the slots or on the surfaces.

Examples:

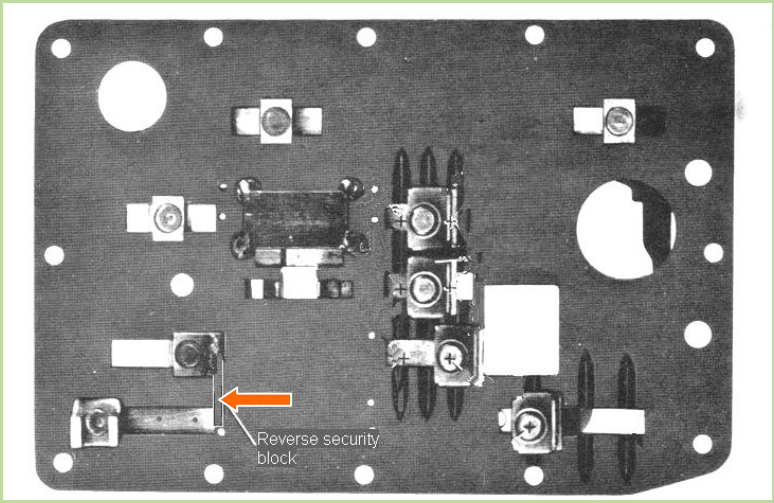
Here are some different images of a shifting plate after welding the small steel plate:



This is an original from a U421 from Gaggenau



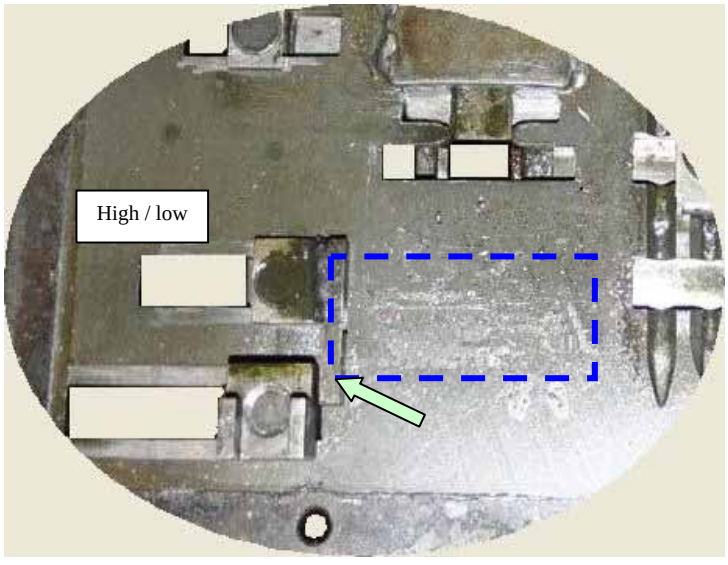
This one is an 'user' modified from a U404

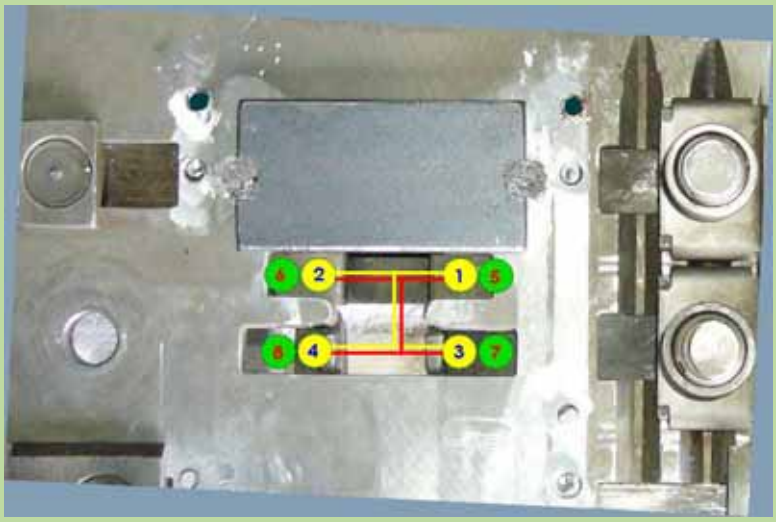


Another view from an old manual……

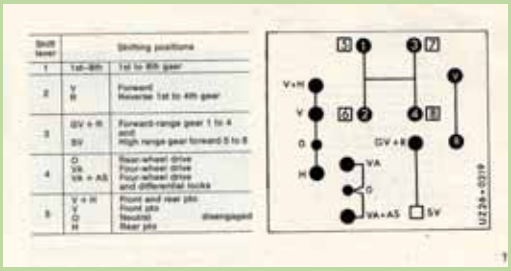
Later we have to weld a piece of steel saved from the old fork to the high/low range slider so that you can go in to reverse gears only in the low range. It makes no sense to drive fast in reverse with a 404S. This lock secures the tranny against bad shifting. Reverse gears work only in the low range to avoid gear salad (!)

Do not do it at this stage, we first need to prepare the additional slider (blue pointed line); it works as a lock ⇩ to allow only the 1st and 2nd gear work in reverse.



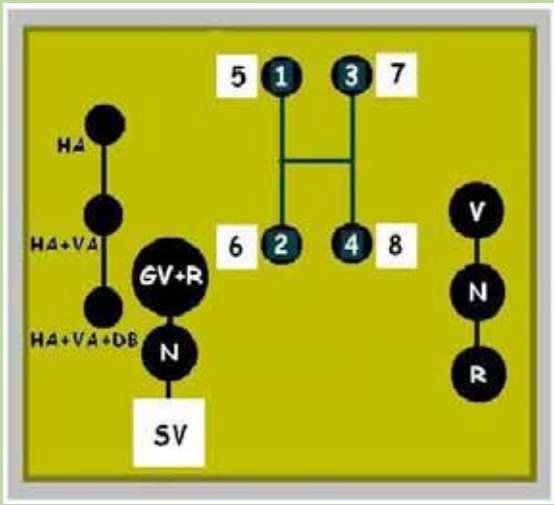


The new shift pattern looks this way. A nice and simple " H " as found in the stock 2x4 transmissions.



A decal from an U421 …

A new decal must be made for…… let's baptize the creature: " OctoTran " (?)



1 ... 8 = Erster bis achter Gang = First to eight gear

V = Vorwärts = Forward

N = Nullstellung = Neutral

R = Rückwärts = Reverse

HA = Hinterachse = Rear axle

VA = Vorderachse = Front axle

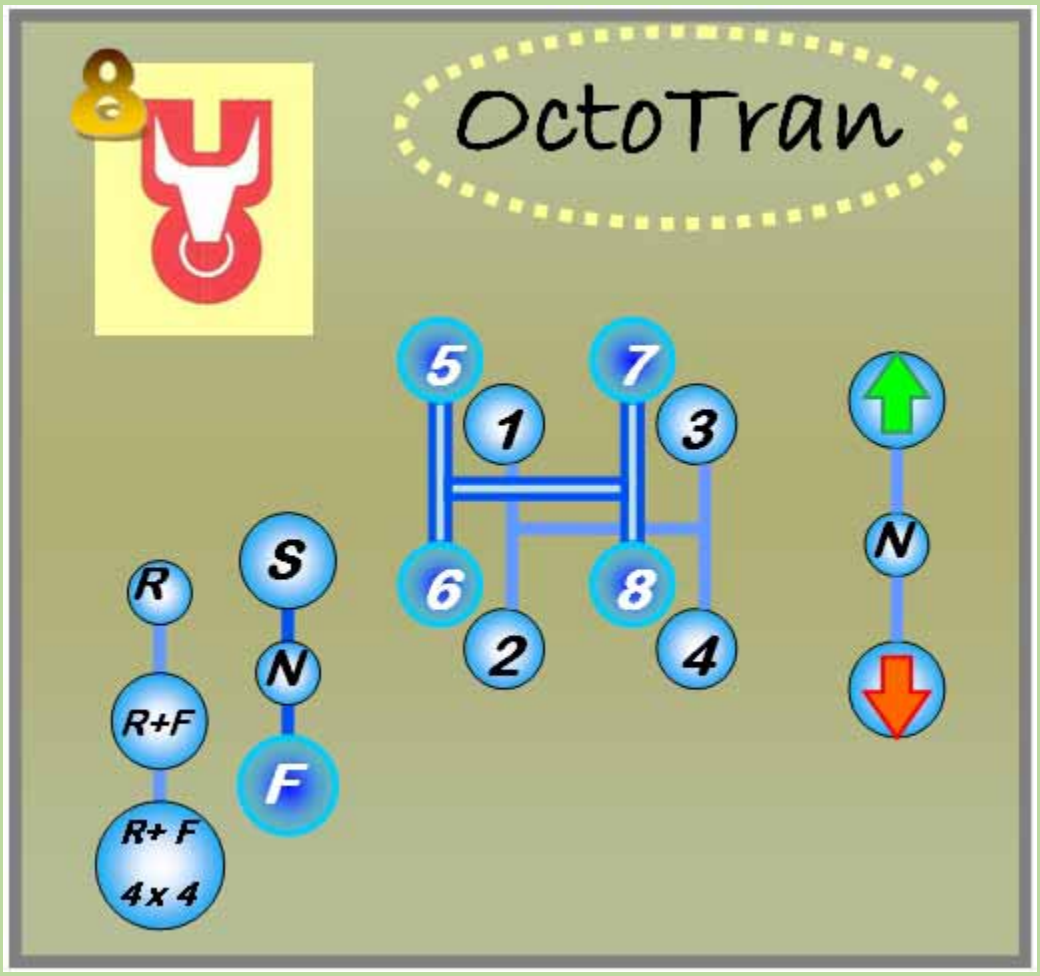
DB = Differentialblockierung = Diff lock

SV = Strasse vorwärts = Street forward

GV = Gelände vorwärts = Off road forward

This is a conservative design, an 'old mog' style decal … (imitation).

Perhaps the " OctoTran " need a special "new" decal : =^D



Legend:

1……..4 = Off road gears, slow.
5…….8 = Street gears, fast(er).
Green arrow = Forward
Red arrow = Reverse
N = Neutral position
S = Slow
F = Fast
R = Rear axle
F = Front axle
R+F 4x4 = Rear and front axle with differential lock

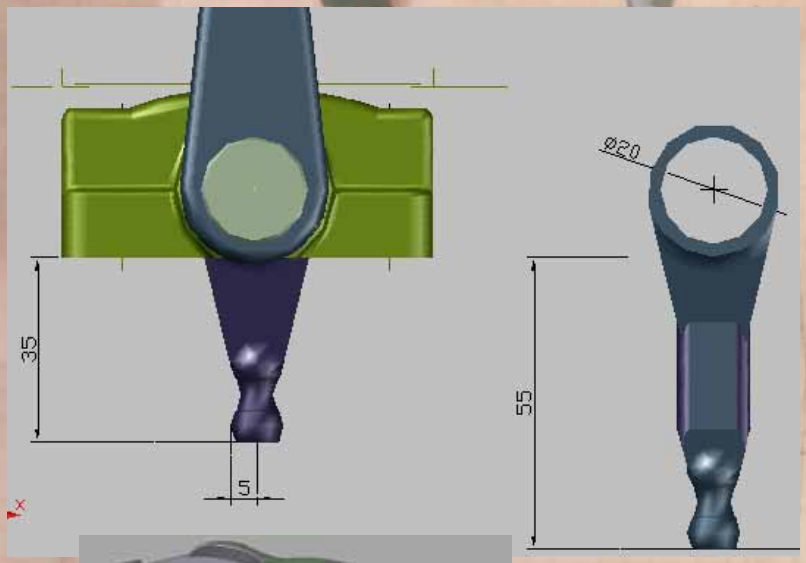
……well, everybody could be creative now and design his decal to the individual tastes.

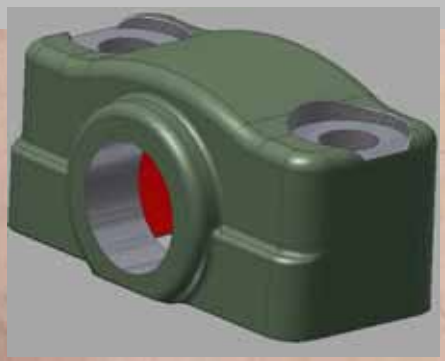
Important: Before shifting from high in to low range, stop the vehicle (as usual). Shifting from the low range in to the high range can be done while driving normally.

Third : The new (additional) shift lever:

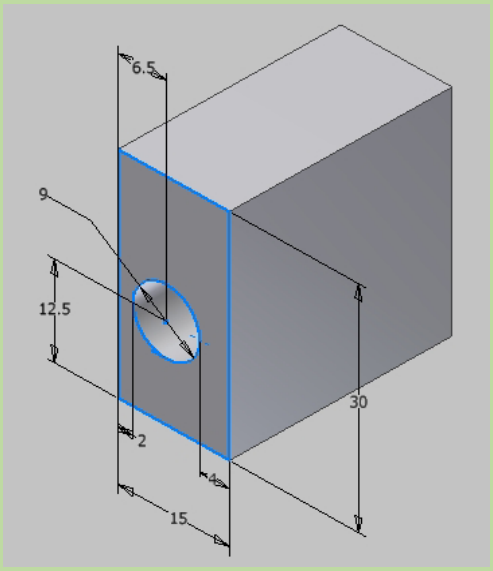
This is the item which demands the most work, believe it or not. Those with luck who found a main cover and a shift plate from a U421 or U406 can finish the mod at once, only swap the two parts. Before taking apart the cover and plate from the 404, shift in to neutral and forward position. Change the levers on the exchange cover and plate to the same positions and the high/low range lever to the high range. Swap the parts, bolt on and you're done. **The procedure is described in the (original) MB shop manual.**

With the parts of a spare transmission from a 404, there is now a little work to be done: A new lever from scratch or from useable parts is to fabricate.



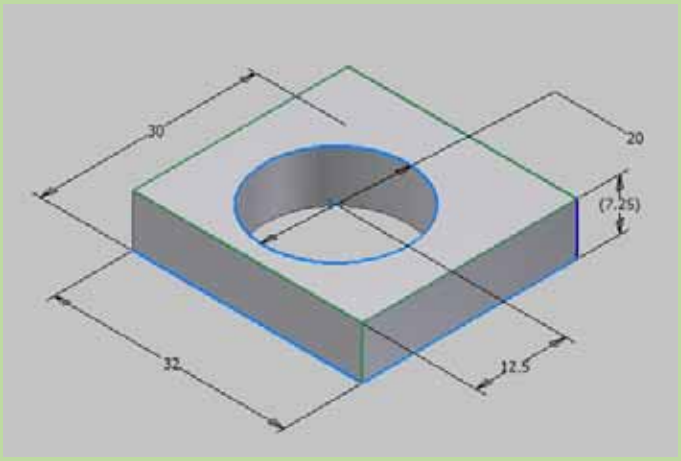


An alternative to construct a lever is - for example - using simple pieces of steel:



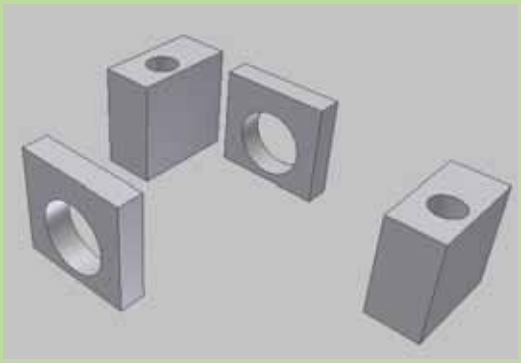
Take the measures from the drawings:

← Two (2) 30mm x 30mm x 15mm piece with a 9mm bore

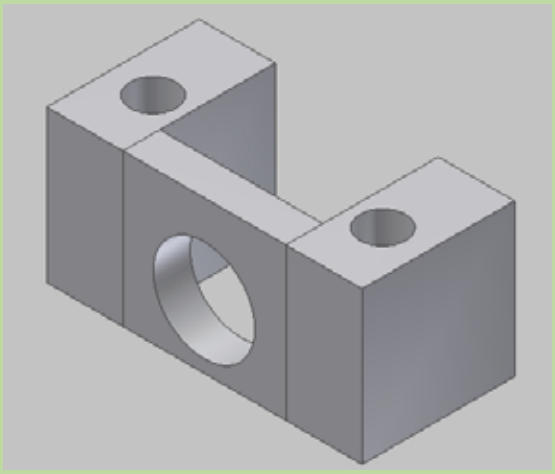


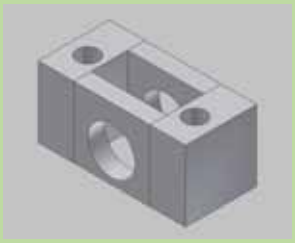
Two (2) 32mm x 30mm x 7.25mm pieces with a 20mm bore ----------→

Assemble and weld …



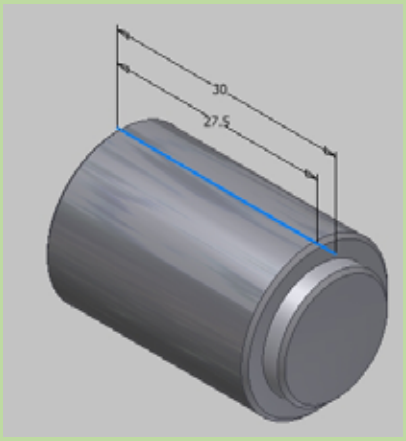
… this way …

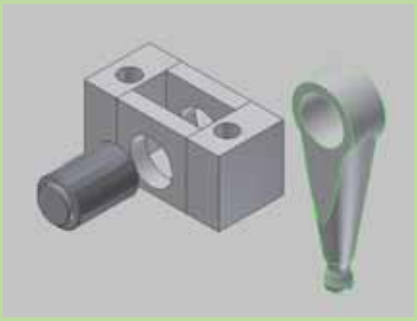




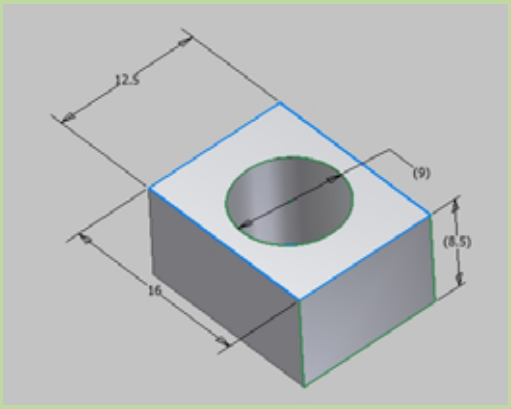
… you get a block for the shift fork assy.

Fire your lathe and fabricate this small shaft. The diameter is 20mm. The small landing is to weld the shaft to the sidewall of the block later .

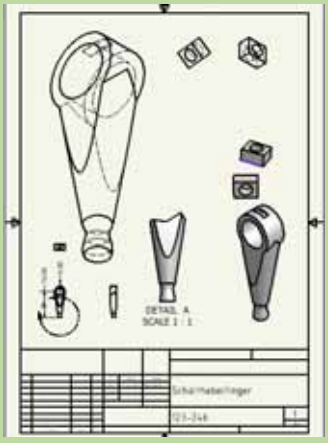




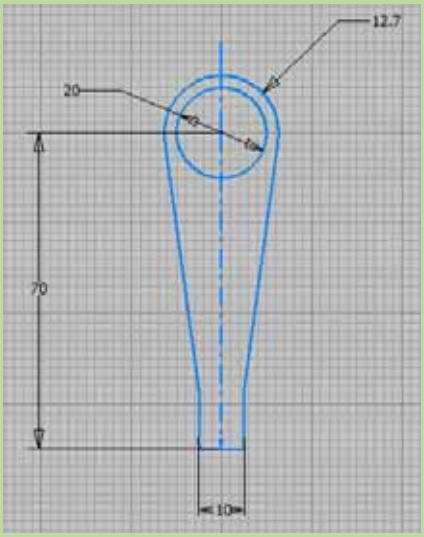
Now fabricate a receiver piece for the shift lever: (16mm x 12.5mm x 8.5mm, the bore is centered). →

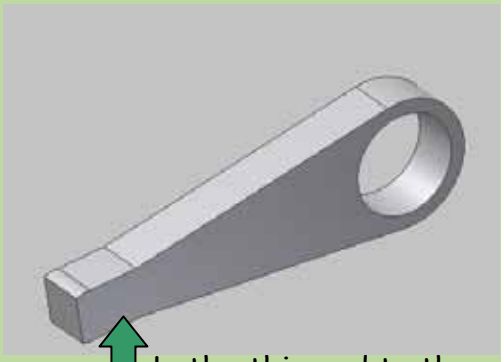


The shift finger could be very simple or more or less elaborated and detailed. (See also page 21)



This very simple type will do the work too:

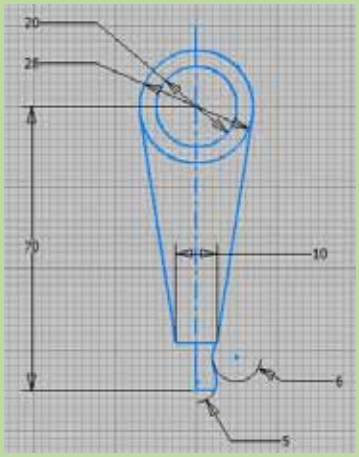


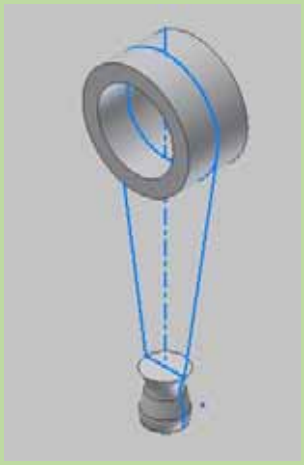


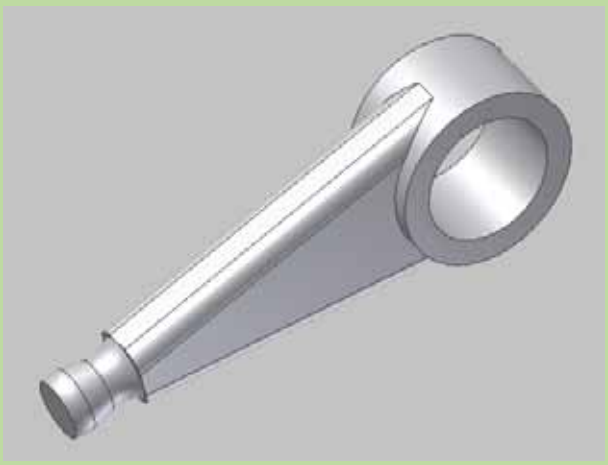
Lathe this end to the shape of the original.

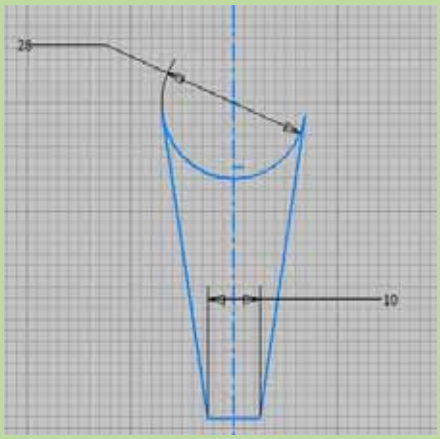
←--------- Weld the receiver part to the (70mm) shift finger

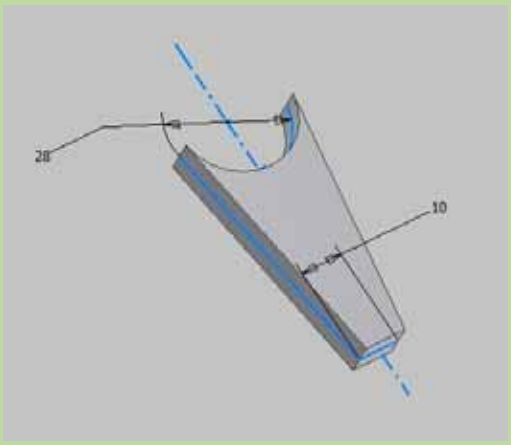
Some other possible steps to make a shift finger……
To make the shift finger I took again material from what remains from the old shift fork of the PTO, it is nice steel, flat, smooth and 10mm thick. That is useful.



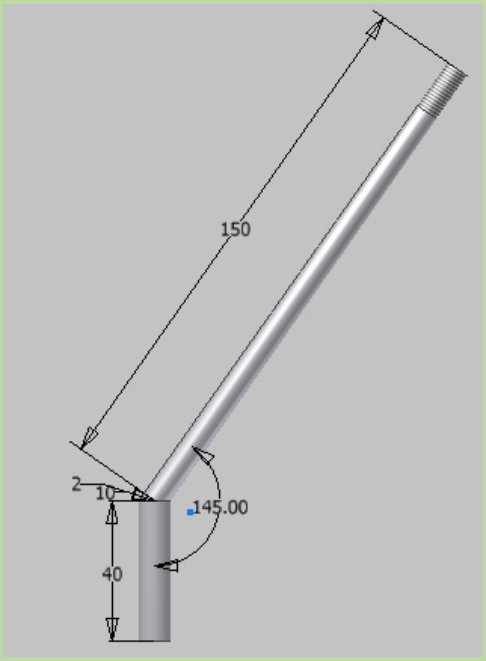


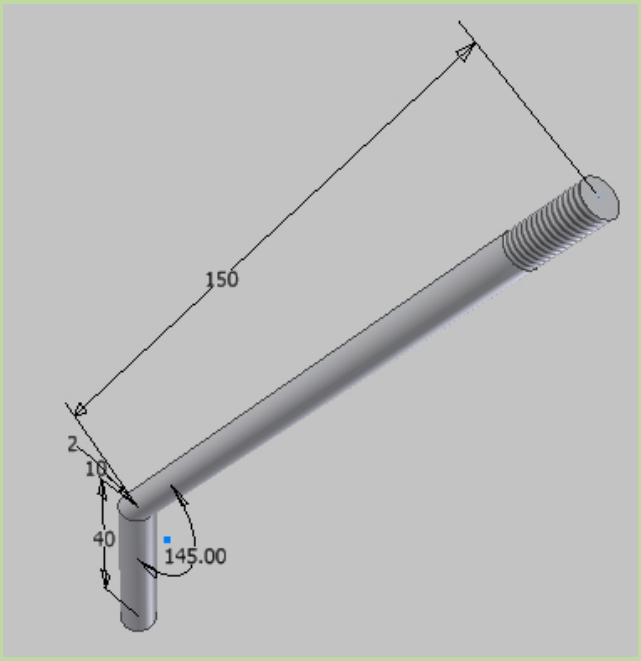




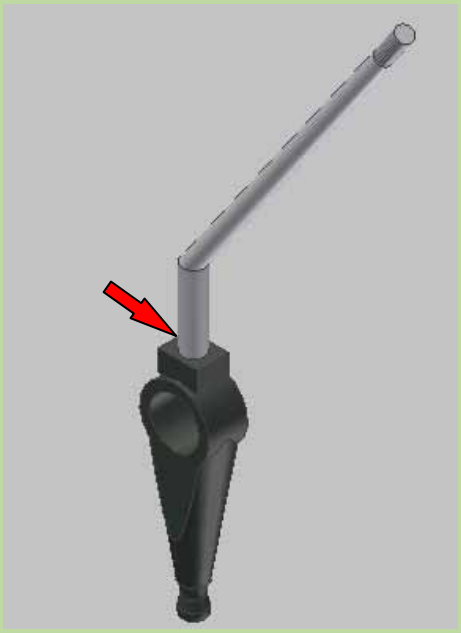


Now make a lever modifying a spare lever or bend something (Φ 9mm) useful into shape:

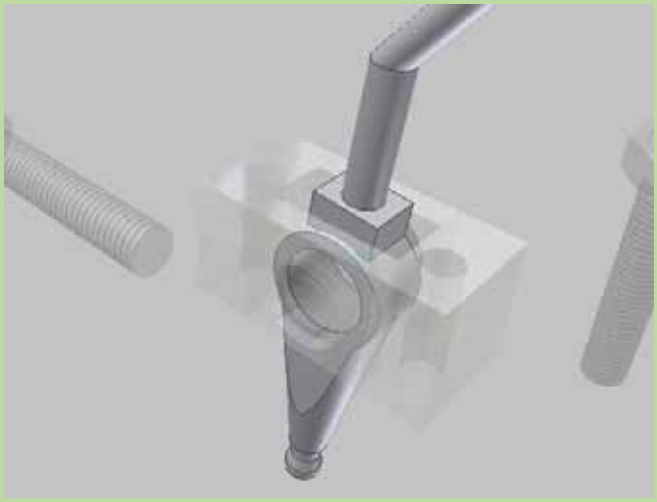




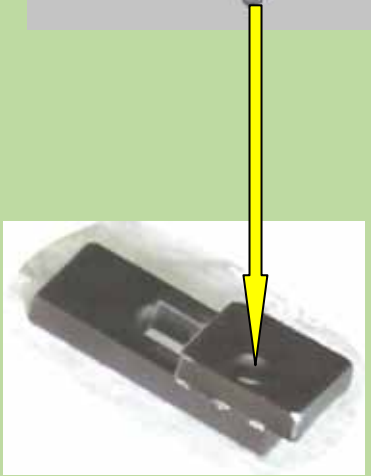
(Sorry, no more real pics (no Mog nearby) – the Mog is sold).
This is the lever & finger assy,



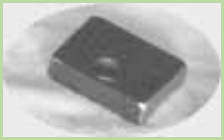
The assembly in the fabricated block.

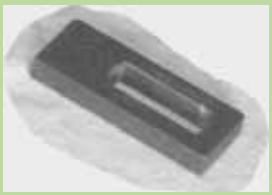


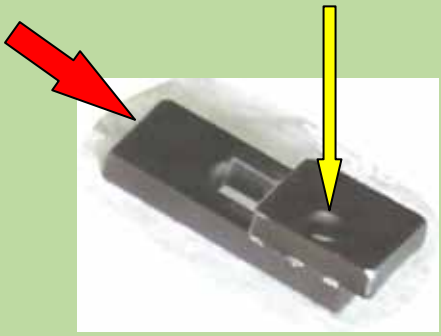
The new finger fit into the receiver on the main shift plate (yellow arrow), This must be measured and arranged on the shift plate and then welded.



The counter part to actuate the high/low slider on the shift plate is made of the two pieces cut from the shift fork (s. page 13).

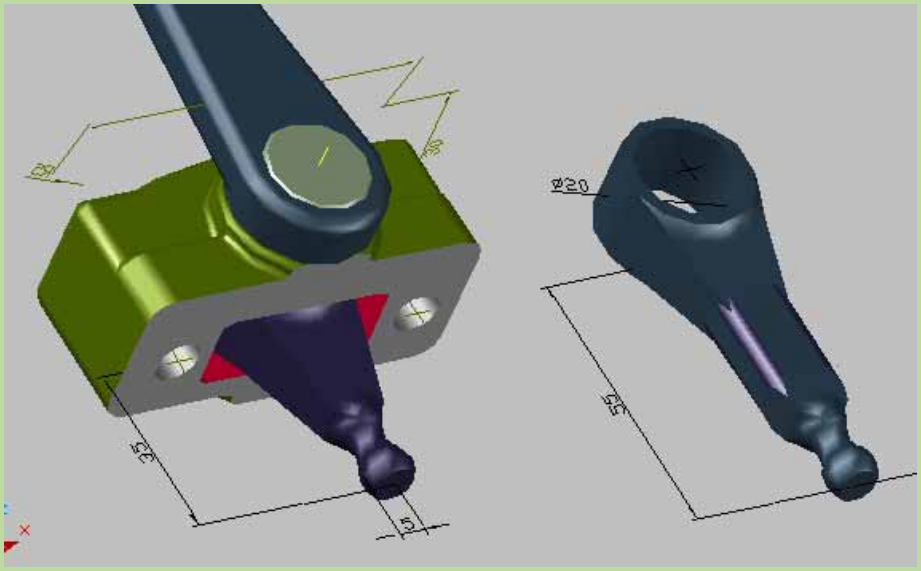




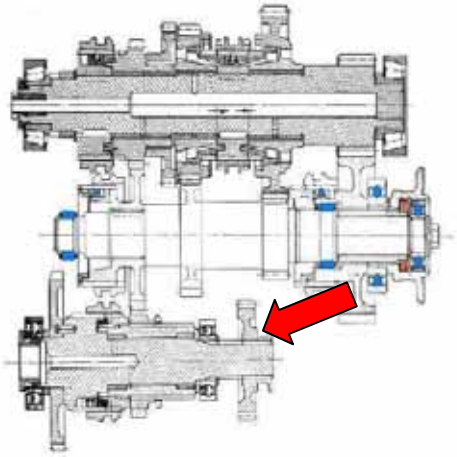


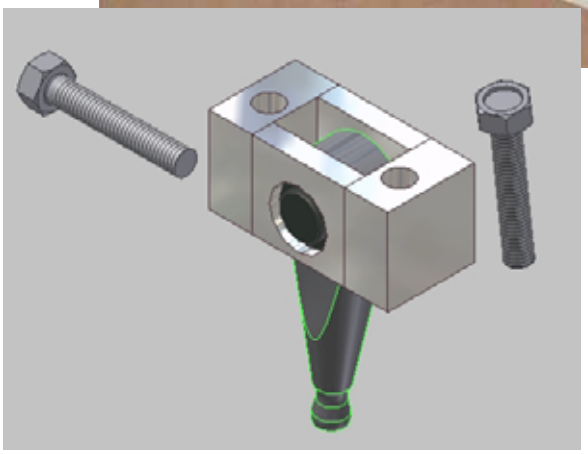
This part will be welded here (red arrow) to the slider of the high/low range shift fork on the shift plate. The yellow arrow points to where the finger of the additional lever connects (see page 25).

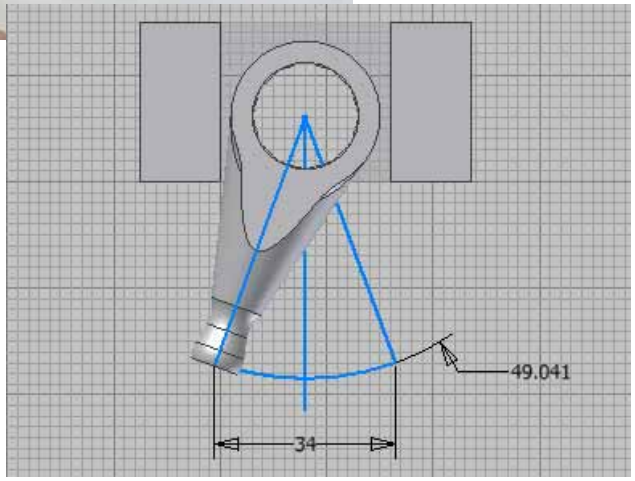
If you have a shop, you perhaps want to fabricate this part from scratch (new) and mill a piece of steel, sure more elegant. (This one is only an example). I'm using up some of the left over parts and material from the modified shifting cover and trying to keep the things simple and easy!



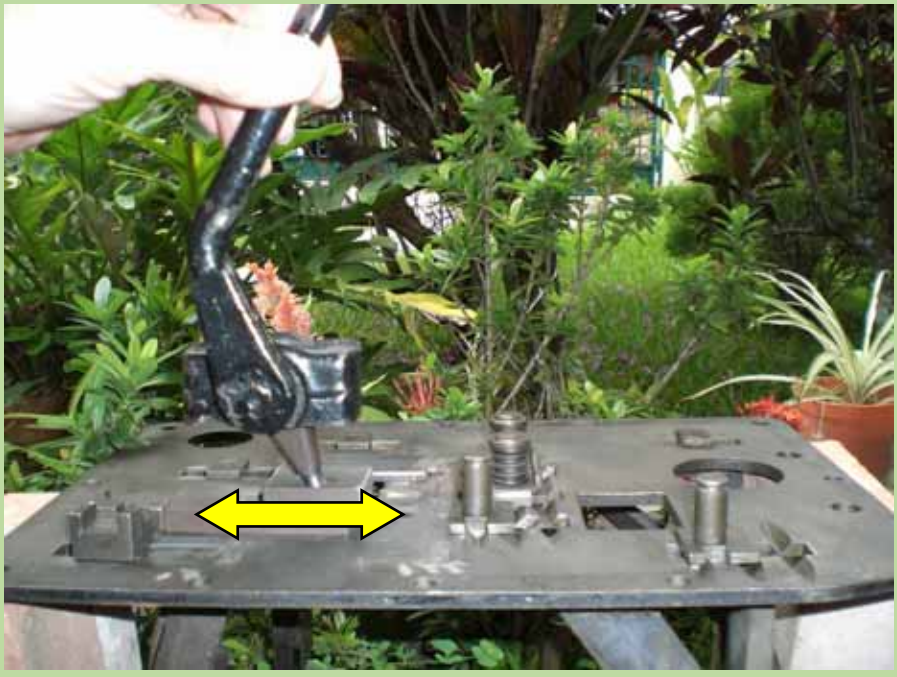
The (useless) pinion of the PTO is to be limited from moving backwards with a little weld point or a punch on the shaft with a chisel, so it could not slide and not touch the housing. (Arrowed red)





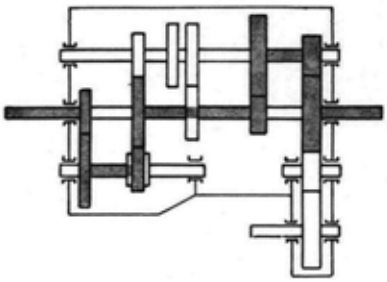


Some other earlier pictures from the shift plate during the work:

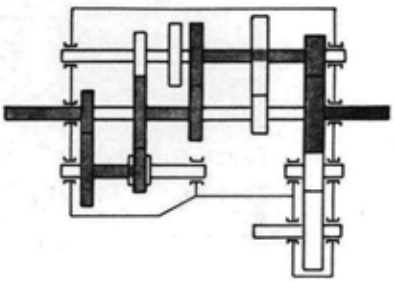


Power flow in various gears of the main transmission after modification :

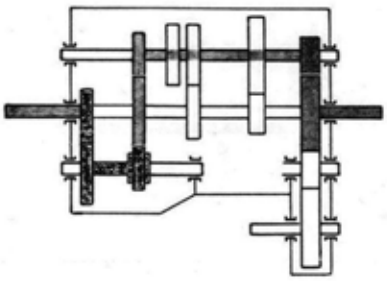
1st Gear



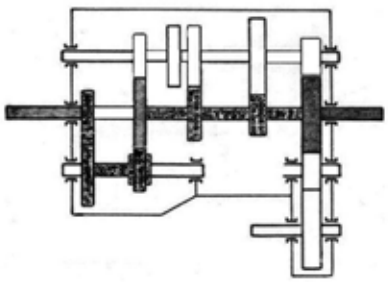
2nd Gear



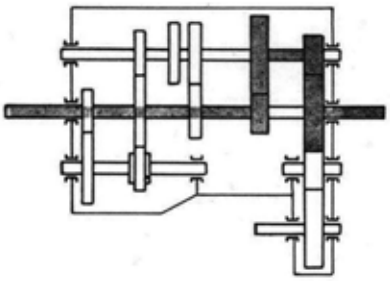
"3rd" low Gear (added)



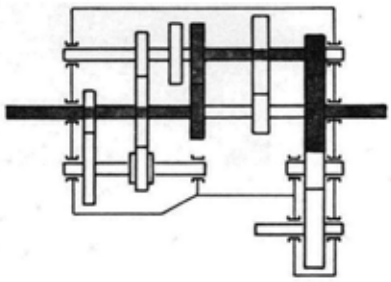
"4th" low Gear (added)



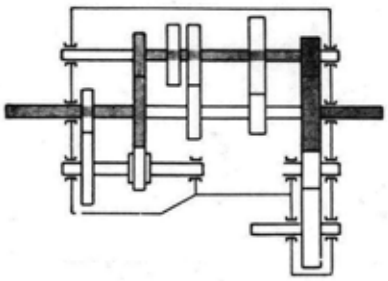
3rd Gear



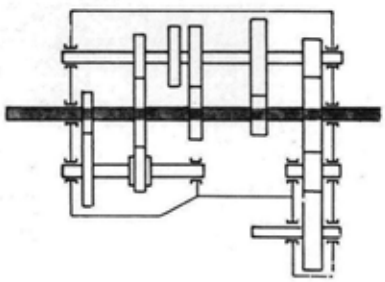
4th Gear



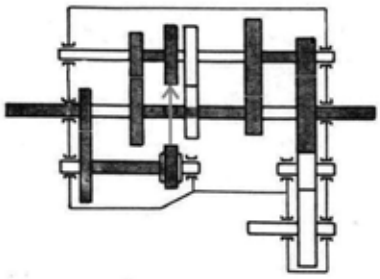
5th Gear



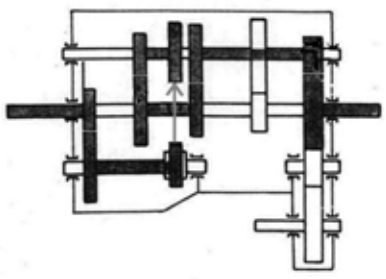
6th Gear



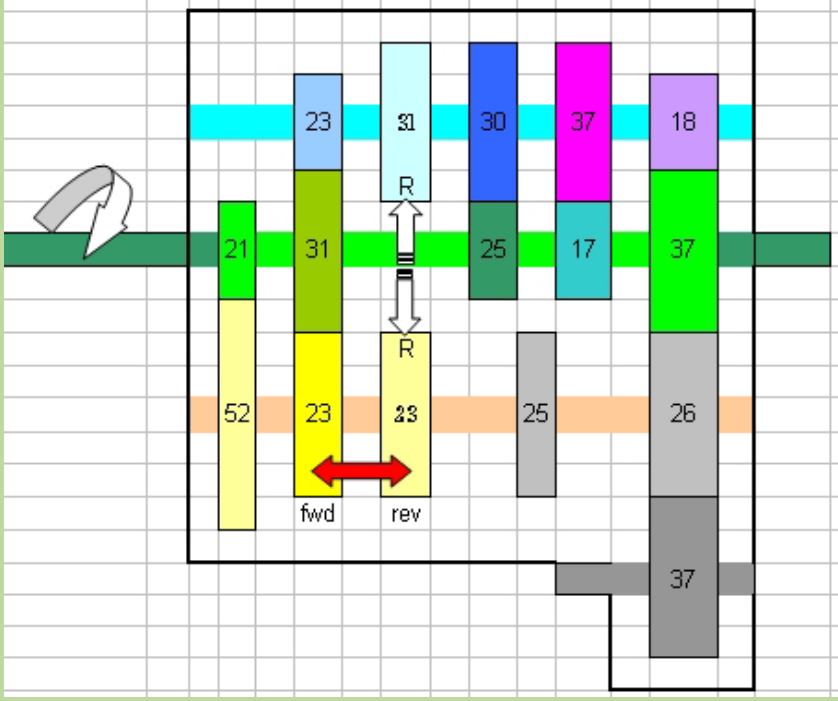
1st Reverse Gear



2nd Reverse Gear



My “tranny” simulator



Forward gears

Gear (Range)	Ratio	Speed(max.) km/h
1st speed low	14.931	7.130
2st speed low	8.232	13.280
3st speed low	5.090	21.000
4st speed low	3.337	31.000
5st speed high	4.474	24.474
6st speed high	2.467	44.400
7st speed high	1.525	72.030
8st speed high	1.000	95.00

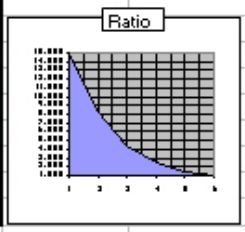
Reverse gears

1st r. low	20.125	5.44
2st r. low	11.096	9.87

Axle ratio (tot.)	7.56

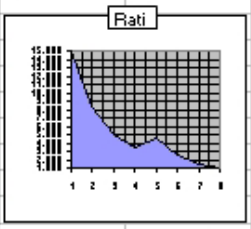
Modification of the UG1/11 shift plate from 6 - to 8 fwd speeds:

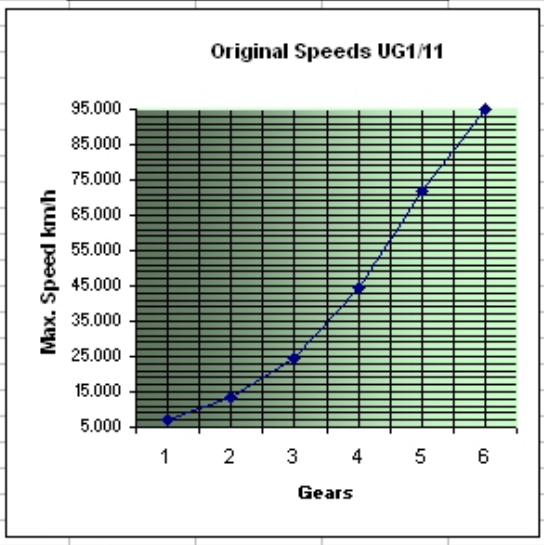
Forward Gears	Original Ratio /1	Max. km/h
(L) 1	14.931	7.130
(L) 2	8.232	13.280
3	4.473	24.474
4	2.466	44.400
5	1.525	72.030
6	1.000	95.000

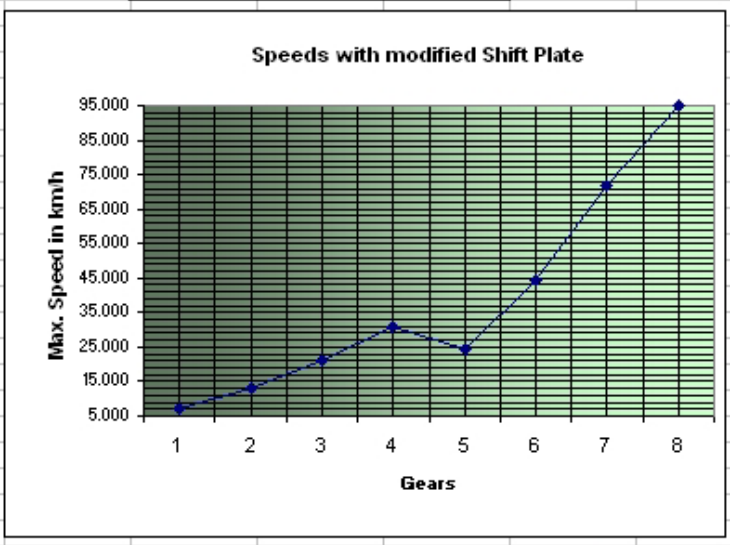


Forward Gears	Extended Ratio /1	Max. km/h
(L) 1	14.931	7.130
(L) 2	8.232	13.280
(L) 3	5.090	21.000
(L) 4	3.337	31.000
5	4.474	24.474
6	2.466	44.400
7	1.525	72.030
8	1.000	95.000

Low range
High range
New gears & speeds





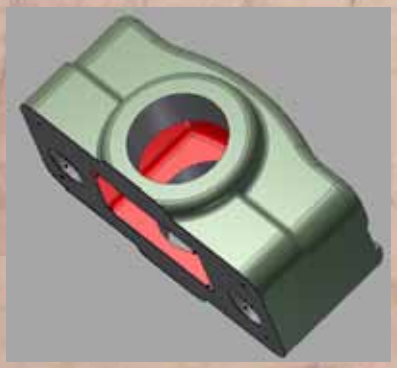


I hope this could be a little guide of one of the possible ways to realize the tranny modification to enjoy the (two more) four off road gears.
This is not the only way to do it. Sure there is even a better one.

But, perhaps I could infect some of you 404 owners with the defiance to do another mod?

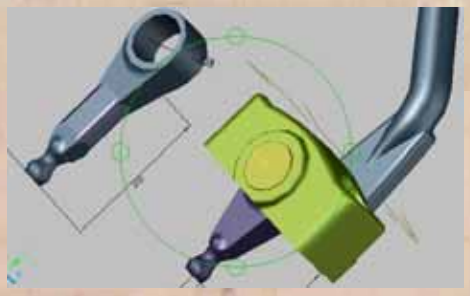
Ah……. no perfectionism intended =^)

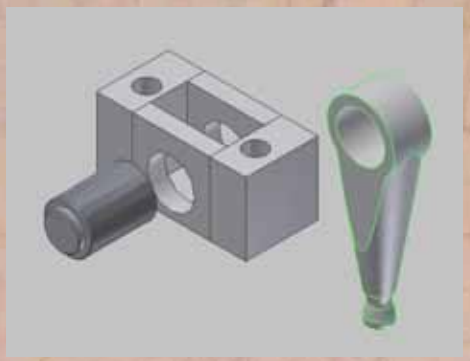
This conception is dedicated to all Moggers from the mog list. Feel free to comment and to drop me a line if you like (bekawe@gmail.com) . Than'X

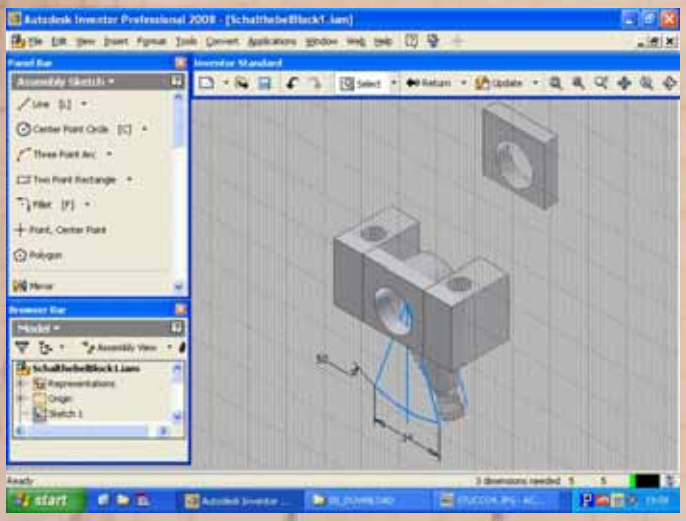


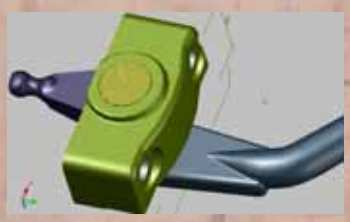
Let me know how you did it !
Cheers, ß .

*









July, @ 2007